

Appl. No. : 10/066,169
Filed : January 30, 2002

COMMENTS

In response to the Final Office Action mailed January 4, 2005, Applicants respectfully request the Examiner to reconsider the above-captioned application in view of the foregoing amendments and the following comments.

Anticipation rejections

Claim 14 stands rejected under 35 U.S.C. 102(b) as anticipated by Chowdhury. Applicants respectfully disagree with the rejection of this claim. Nevertheless, to advance prosecution, Applicants have amended this claim to more particularly and distinctly claim the claimed apparatus for supplying repeated vapor phase reactant pulses to a reaction chamber. Applicants reserve the right to pursue Claim 14 in its original or similar form in a continuing application.

As amended, Claim 14 recites, in part, “a first sensor that is in communication with the gas conduit system at a position upstream of the reaction chamber and provides a first signal indicative of a first characteristic parameter of the reactant pulses at the position upstream of the reaction chamber as a function of time; and a diagnostic and control unit that is configured to generate a first curve from the first sensor and to monitor changes over time in a shape of the first curve during subsequent reactant pulses.” (Underlining indicates language added to Claim 14 in this Amendment).

In contrast, Chowdhury discloses the use of mass spectroscopy to observe, in real time, the gas composition within the exhaust port or within the reaction chamber. See page 128, first paragraph. For at least this reason, the rejection of Claim 14 as anticipated by Chowdhury is in error.

Rejections under 35 U.S.C. 103(a)

Claims 1-43 stand rejected under 35 U.S.C. 103(a) as unpatentable over Min in view of Chowdhury and further in view of Schmitt (USPN 6,038,919). Applicants respectfully disagree with the rejection of these claims. Nevertheless, to advance prosecution, Applicants have amended these claims as outlined below. Applicants reserve the right to pursue these claims in their original or similar form in a continuing application.

Independent Claim 1 recites, in part, a method for determining changes in a reactant supply system comprising providing “a first sensor that is in communication with the conduit system at a point upstream of the reaction chamber and downstream of the reactant source, the first sensor providing a first signal indicative of a first characteristic parameter

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of the reactant pulses as a function of time; generating a first curve having a shape from the first signal for the repeated reactant pulses; and monitoring the shape of the first curve to determine changes in the shape of the first curve over time, the changes in the shape of the first curve being indicative of changes in a supply of repeated reactant pulses to the reaction chamber.”

Chowdhury does not disclose, teach or suggest placing the mass spectroscopy device in communication with the gas conduit that connects the reactant source to the reactant chamber. Rather, Chowdhury discloses placing a sensor downstream of such conduits. This distinction is important. Applicants’ recited sensor location enables determination of the remaining reactant in the source. Chowdhury’s location does not, since Chowdhury senses chemicals after reaction. Measurements at this point cannot accurately reflect an amount of reactant left in the source container.

Schmitt discloses a method for determining how much solid or liquid precursor is left in a container. The method utilizes a pressure detector 40 and temperature sensor 42 positioned upstream of the process chamber. However, the method involves closing an outlet of the container to define a measurement volume. Col. 4, lines 2-10. A metered amount of gas is then delivered to the measurement volume. *Id.* The pressure and temperature are measured at separate times to calculate the amount of reactant remaining in the container according to a specific equation Col. 4, lines 35-65.

Min merely discloses an exemplary ALD reactor and a method of operating such an ALD reactor. ~~-----~~

The Examiner states that it “would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate a sensor as taught by Chowdhury or Schmitt into the device and method of Min.” Applicants respectfully disagree.

First, as noted above, Chowdhury discloses placing a sensor downstream or within the reaction chamber in order to monitor the reactions in the reaction chamber. Chowdhury does not disclose, teach or suggest sensing “at a point upstream of the reaction chamber and downstream of the reactant source.” In addition, it would not have been obvious to combine Chowdhury and Schmitt. As noted above, Schmitt discloses a very specific method of calculating the amount of reactant remaining in a source container. The method utilizes a specific equation that uses temperature and pressure measurements to calculate volume. Thus, there is no motivation to combine the mass-spectrometry device as taught by

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Chowdhury with the method and apparatus of Schmitt. In other words, there is no motivation to use mass-spectrometry measurements to calculate volume using temperature and pressure as taught by Schmitt.

In addition, Chowdhury discloses monitoring the reaction process in real-time. In contrast, the method and apparatus of Schmitt relies on isolating the container to define a measurement volume. The volume of gas is determined by using an equation that utilizes pressure and temperature measurements at an ending time t_2 and a starting time t_1 . Col. 4, lines 10-12. Thus, there is no motivation to monitor the pressure or temperature in Schmitt in real time in order to determine the remaining volume in the source container.

Because there is no motivation to combine the references as suggested by the Examiner, Applicants respectfully submit that Claim 1 is in condition for allowance. Claims 2-13 depend upon Claim 1 and, for at least this reason, these claims are also in condition for allowance.

As noted above, independent Claim 14, recites, in part, an apparatus which comprises “a first sensor that is in communication with the gas conduit system at a position upstream of the reaction chamber and provides a first signal indicative of a first characteristic parameter of the reactant pulses at the position upstream of the reaction chamber as a function of time; and a diagnostic and control unit that is configured to generate a first curve from the first sensor and to monitor changes over time in a shape of the first curve during subsequent reactant pulses.”

As noted above, Chowdhury does not disclose, teach or suggest placing the mass spectroscopy device in communication with the gas conduit at the position upstream of the reaction chamber. In addition, as outlined above, there is no motivation to combine Chowdhury with Min and Schmitt as suggested by the Examiner. For at least this reason, Applicants submit that Claim 14 is in condition for allowance. Claims 15-24 depend upon Claim 14 and, for at least this reason, these claims are also in condition for allowance.

As amended, independent Claim 25 recites, in part, “generating a first curve from the first signal as a function of time, the first curve having a shape characteristic of the repeated vapor phase reactant and purging pulses while the reactant and purging pulses are being supplied to the reaction chamber; monitoring the shape of the first curve to determine changes indicative of changes in a supply of repeated reactant pulses to the reaction chamber; and in response to the changes in the shape of the first curve, replacing

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the reactant source with a second reactant source that comprises a solid and/or liquid reactant and a vaporizing mechanism.”

As noted above, Schmidtt discloses a very specific method for determining how much solid or liquid precursor is left in a container. The method utilizes temperature and pressure measurements taken at a discrete time and a specific equation. There is no motivation to combine real time in-situ mass spectrometry as taught by Chowdhury into the method and apparatus for determining the amount of solid or liquid precursor that is left in a container. For at least this reason, Applicants submit that Claim 25 is in condition for allowance. Claims 26-34 depend upon Claim 25 and, for at least this reason, these claims are also in condition for allowance. Please note that the dependence of Claim 27 has been changed.

As amended, independent Claim 35 recites, in part, a method comprising a “method for determining changes in an amount of reactant in a first reactant source within an atomic layer deposition (ALD) system, the method comprising: monitoring pressure in a conduit that communicates with a reactant source container in the ALD system; generating a pressure signal corresponding to the monitored pressure during at least a first ALD cycle and at least a second ALD cycle; and comparing a pattern of the pressure signal over time during at least the first ALD cycle to a pattern of the pressure signal over time during at least the second ALD cycle.”

Again, as noted above, while Chowdhury discloses using mass-spectrometry to make real-time measurements, Schmidtt discloses using temperature and pressure measurements taken at discrete times to calculate gas volume in a container. As such, there is no suggestion or motivation to use real time measurement let alone “a pattern of the pressure signal sensor over time” in the apparatus and method of Schmitt.

Accordingly, Applicants submit that Claim 35 is in condition for allowance. Claims 37-43 depend on Claim 35 and, for at least this reason, these claims are also in condition for allowance. Claim 36 has been canceled without prejudice.

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CONCLUSION

For the foregoing reasons, it is respectfully submitted that the rejections set forth in the outstanding Office Action are inapplicable to the present claims. Accordingly, early issuance of a Notice of Allowance is most earnestly solicited.

The undersigned has made a good faith effort to respond to all of the rejections in the case and to place the claims in condition for immediate allowance. Nevertheless, if any undeveloped issues remain or if any issues require clarification, the Examiner is respectfully requested to call Applicants' attorney in order to resolve such issue promptly.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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